March 19, 2020

BY ELECTRONIC FILING

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

Re: *Unlicensed Use of the 6 GHz Band*, ET Docket No. 18-295

Dear Ms. Dortch,

As the Commission considers recent filings relating to low-power indoor and very-low-power unlicensed operations in the 6 GHz band, we write to highlight the deep and stable record already developed on Automated Frequency Coordination ("AFC") for standard-power[1] indoor/outdoor devices operating in U-NII-5, U-NII-7, and the lowest 100 MHz of U-NII-8. The record reflects strikingly broad agreement that, with the right rules, AFC control will be an effective means of preventing harmful interference for this class of devices.[2] Indeed, the discussion in the record has centered on the question of which devices must be subject to control by an AFC, not whether the AFC approach is suitable for protecting licensees from harmful interference.

As we have explained,[3] an AFC implementation need not be complex in order to be effective. However, unnecessarily burdensome AFC requirements could greatly increase the cost

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[1] As used herein, "standard power" refers to devices with radiated power of at least 30 but not greater than 36 dBm EIRP.

[2] *See, e.g.*, Comments of National Public Safety Telecommunications Council at 10, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019); Comments of CTIA at 2, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019); Comments of Fixed Wireless Communications Coalition at 22, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) ("FWCC Comments"); Comments of AT&T Services, Inc. at 4, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019); Comments of Tucson Electric Power Company and UNS Electric, Inc. at 14, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) ("Tucson Electric Comments"); Comments of Wi-Fi Alliance at 10, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) ("Wi-Fi Alliance Comments"); Comments of RLAN Group at 39-49, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) ("RLAN Group Comments"); Comments of the Ultra Wide Band Alliance at 4, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019).

[3] *See* RLAN Group Comments at 49-68.

of AFC implementations, delaying the availability of AFC-controlled devices, limiting innovation, and driving up costs for consumers.

Given these factors, the record strongly supports a decision by the FCC to quickly adopt a set of foundational rules for AFC-controlled operations and certifying AFC implementations.

I. THE COMMISSION SHOULD EXPEDITIOUSLY ADOPT A MINIMUM SET OF AFC REQUIREMENTS.

Our companies strongly support the Commission's long history of light-touch, technology-neutral and innovation-friendly decision-making, especially with respect to unlicensed operations. We hope the Commission continues in this tradition by adopting a targeted, concise set of rules and findings related to AFC to support industry stakeholders' efforts to develop AFC standards and, ultimately, production-ready AFC systems.

Stakeholders are working today to develop these standards. However, clear FCC guidance is required on several important topics in order for this work to advance. Fortunately, the depth and degree of agreement in this docket surrounding AFC afford the Commission the opportunity to speed the availability of AFC-controlled devices to American consumers by adopting rules regarding a limited but fundamentally important set of core aspects of AFC operation.

As part of its decision to open all 1,200 MHz of the band for unlicensed operation, the Commission should adopt rules for at least the following four items:

1. The AFC should protect fixed-service ("FS") receivers from RLAN signals that would exceed -6 dB I/N on a single-entry basis.

2. Multiple entities will be permitted to operate independent AFC implementation, without burdensome AFC-to-AFC synchronization or registration requirements, which are unnecessary to prevent harmful interference but would dramatically increase AFC complexity and compromise user privacy.

3. Consistent with WinnForum's proposal,[4] AFC implementations should be authorized to employ the following path-loss model: (1) for RLAN-to-FS receiver distances up to one kilometer, the WINNER II Combined Urban (C2) model and WINNER II Combined Suburban (C1) models for urban and suburban areas respectively, and the Irregular Terrain Model (ITM) combined with ITU-R P.452 clutter model for rural areas; (2) for RLAN-FS Receiver distances greater than one kilometer, the ITM combined with ITU-R P.2108 clutter model for suburban and urban environments, and (3) ITU-R P.452 clutter for rural environments.

[4] Wireless Innovation Forum, *Propagation Models and Interference Protection Criteria for Sharing between the Fixed Service and Unlicensed Devices in the 6 GHz Band* WINNF-TR-1002, 28 (V1.0.0, 2019).

4. AFC implementations should base their interference-protection calculations for the protection of FS links on ULS data.

To help facilitate and expedite work by industry stakeholders after the release of an Order, the Commission should also make the following five findings:

1. That neither adjacent channel nor aggregate interference protections are required;
2. AFC implementations should provide interference-protection assessments in three dimensions—i.e., taking both FS receiver and RLAN transmitter height into account;
3. The AFC should perform interference-protection assessments using accurate terrain, clutter, and FS antenna patterns whenever that information is available or, when it is not available, using conservative models;
4. The Commission's rules should be technology neutral with respect to the geolocation techniques that an AFC-controlled access point may employ, so long as a device's associated location uncertainty (in all three dimensions) is taken into account in interference-protection assessments;
5. The AFC, and AFC-controlled devices, should be subject to robust security requirements to ensure that AFC functionality is not modified or circumvented.

The Commission has a strong foundation of substantial—and in some cases unanimous agreement—on virtually every item on these two lists, which are also supported by extensive FCC precedent.[5] This light-touch, proactive approach will speed AFC devices to market and incentivize early investment by making clear that the core "rules of the road" have been settled.

II. THE AFC SHOULD USE CONSERVATIVE TECHNICAL PARAMETERS.

Below, we review the state of the record on each of the key technical operating parameters that AFC implementations should incorporate:

Frequencies of Operation

[5] *See, e.g.*, 47 C.F.R. §§ 15.712 (adopting predefined propagation models/exclusion areas for interference protection assessments; adopting interference-protection zones on a single-entry basis; adopting interference protection rules that account for actual height and antenna pattern of protected licensee; allowing multiple database administrators); 15.711(b) (requiring only "a geo-location capability" and permitting variable geolocation accuracy so long as accuracy can be determined with 95% confidence); 96.63 (permitting certification of multiple Spectrum Access System administrators); 96.39 (establishing technology-neutral geo-location rules and permitting professional installation to serve as a geo-location technique).

Standard-power, indoor/outdoor operations under control of an AFC should be permitted in U-NII-5, U-NII-7, and the bottom 100 MHz of U-NII-8.[6]

Interference Protection Threshold

The AFC should implement an interference protection criterion of -6 dB I/N[7] on a single entry basis. The record makes clear that there is no need for aggregate interference protections, which would greatly complicate the design of AFC systems.[8]

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[6] *See, e.g.*, Comments of Qualcomm Incorporated at 11, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019); Comments of Broadcom Inc. at 45, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) ("Broadcom Comments"); Comments of The Wireless Internet Service Providers Association at 26, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) ("WISPA Comments"); FWCC Comments at 22 (arguing that AFC is necessary for U-NII-5 and U-NII-7, without taking a position on U-NII-8); Reply Comments of The Utilities Technology Council, the Edison Electric Institute, The American Public Power Association, The National Rural Electric Cooperative Association, The American Petroleum Institute, and The American Water Works Association at 14, ET Docket No. 18-295, GN Docket No. 17-183 (filed Mar. 18, 2019).

[7] *See*, *e.g.*, FWCC Comments at 22; Comments of the Association of American Railroads at 11, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019); Tucson Electric Comments at 11-12; Wi-Fi Alliance Comments at 15; Broadcom Comments at 22; Letter from Rob Alderfer, Vice President of Technology Policy, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183, at 3 (filed Mar. 13, 2020); Letter from David Don, Comcast Corporation, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183, at attachment 1 (filed Mar. 5, 2020); Letter from Edison Electric Institute, National Rural Electric Cooperative Association, American Gas Association, Utilities Technology Council, American Public Power Association, Nuclear Energy Institute, and American Water Works Association to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183, at 2 (filed Feb. 7, 2020).

[8] *See, e.g.*, RLAN Group Comments at 41; Reply Comments of Wi-Fi Alliance at 29, ET Docket No. 18-295, GN Docket No. 17-183 (filed Mar. 18, 2019); Letter from Mitchell Lazarus and Donald Evans, Counsel to the Fixed Wireless Communications Coalition, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183, at 9 (filed Oct. 31, 2019); Letter from Paul Margie, Counsel to Broadcom Inc. and Hewlett Packard Enterprise, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183, at 1 (filed Aug. 22, 2019); RKF Engineering, *Frequency Sharing for Radio Local Area Networks in the 6 GHz Band* 12 (2018), *as attached to* Letter from Paul Margie, Counsel to RLAN Group, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 17-183 (filed Jan. 25, 2018).

This interference protection should be calculated only for RLAN devices seeking to operate co-channel with an FS link. There is no need for special adjacent-channel protections.[9]

Propagation Models

The record demonstrates that the FCC should authorize AFC implementations that employ the following propagation models for use in conducting interference-protection assessment, which vary depending on whether the AFC-controlled access point is located in either a rural or urban/suburban area, with a view towards permitting other models if they can be demonstrated to be effective:[10]

Table 1: Urban & Suburban Propagation Models

Distance	Propagation Model	Clutter	Building entry
0 m ≤ d < 1000 m	WINNER II Combined Urban (C2) ; *or* WINNER II Combined Suburban (C1)	*n/a*	Recommendation ITU-R P.2109-1
$d \geq$ 1000 m	ITM plus digital elevation model (1as resolution)	Recommendation ITU-R P.2108-0 (p=50%)	Recommendation ITU-R P.2109-1

Table 2: Rural Propagation Model

Distance	Propagation Model	Clutter	Building entry
$d \geq$ 0 m	ITM plus digital elevation model (1as resolution)	Recommendation ITU-R P.452-16	Recommendation ITU-R P.2109-1

These propagation models should be applied taking real-world RLAN transmitter and FS receiver heights into account. This will ensure that interference-protection assessments are as accurate as possible, increasing the robustness of the AFC's interference protection as well as optimizing the spectrum available for RLAN operations. Similarly, the AFC should be permitted to use real-world terrain, clutter, and FS antenna patterns whenever that information is available. When it is not, AFC implementations should be permitted to employ conservative industry-standard models to provide these parameters.

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[9] *See* Reply Comments of RLAN Group at 26-30, ET Docket No. 18-295, GN Docket No. 17-183 (filed Mar. 18, 2019); Letter from RLAN Group to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 12, 2020).

[10] *See* RLAN Group Comments at 43, Declaration of Dr. Vinko Erceg. *See also, e.g.*, Wi-Fi Alliance Comments at 25; Letter from Rob Alderfer, Vice President of Technology Policy, CableLabs, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183, at 3 (filed Mar. 13, 2020).

FS Receiver Information

The AFC should draw all necessary data from the FCC's Universal Licensing System ("ULS"). Because some FS incumbents have raised doubts about the accuracy of ULS registration data, the Commission should open an amnesty window during which FS licensees should be permitted to update their registration data without filing fees and without risking penalties for having failed to maintain accurate ULS registrations in the past.[11] To maximize the time available for licenses to make any necessary corrections, the Commission should open a window for ULS data corrections as soon as possible.

Beyond the need for certain licensees to correct their ULS registration data, the record makes clear that ULS is well suited to provide AFC implementation with the information necessary to protect FS links.[12]

Access Point Geolocation

The Commission should permit AFC-controlled access points to employ any geolocation method to determine their position with a confidence of 95%—i.e., AFC access points must have 95% confidence—that they are within the zone defined by their reported location with a margin of accuracy, expressed as a distance, associated with that location measurement. There are multiple means available today such as built-in geolocation using technologies like GPS, professional installation, and street address lookup. Each may have important advantages, depending on the deployment context. For example, GPS often does not perform well indoors, potentially making professional installation or other approaches a necessity in these environments. In the future, other methods may also become available. The Commission should not foreclose these possibilities today through unnecessarily restrictive rules. Instead, it should leave open the possibility of future innovation and allow the market to determine the most appropriate geolocation approach for a given purpose.

The AFC will determine spectrum availability for a given access point based on its reported location and location uncertainty. A device may report its location with greater or lesser uncertainty—but with the required level of confidence—due to limitations in its location technology, anticipated movement of the device between spectrum availability requests, or

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[11] The FCC's authority to waive these filing fees is unambiguous. *See* 47 U.S.C. § 159a(d).

[12] *See, e.g.*, Letter from Alex Roytblat, Senior Director of Regulatory Affairs, Wi-Fi Alliance, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183, at slide 13 (filed Apr. 18, 2019); Tucson Electric Comments at 19-20; Reply Comments of CenturyLink at 4, ET Docket No. 18-295, GN Docket No. 17-183 (filed Mar. 18, 2019); Comments of Dynamic Spectrum Alliance at 10, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019).

where it may determine that operation with a reduced number of available channels is an acceptable consequence of reporting its location with greater uncertainty.[13]

AFC Control of Transportable Devices

The Commission should permit AFC-controlled devices to be transportable, as well as fixed. The Commission has already decided in other proceedings that access points subject to database control need not be fixed, so long as transportable devices are able to report their velocity (or the resulting location uncertainty) to allow available frequencies to be reduced accordingly.[14] This flexibility will enable a number of important use cases, such as AFC-controlled access points on school buses, connectivity for first responders and other public safety users, and military applications.

III. THE COMMISSION'S RULES SHOULD EMPHASIZE SECURITY AND ROBUST INTERFERENCE PROTECTION, BUT AVOID MANDATING UNNECESSARY COMPLEXITY.

The Commission's goal in designing its AFC rules should be enabling the greatest degree of flexibility possible for device manufacturers and AFC operators, while ensuring that incumbents are protected from harmful interference.

To this end, the Commission should design AFC operator rules that allow the Commission to:

1) Verify an AFC operator's technical qualifications to operate the AFC,
2) Ensure that an AFC implementation is secure, and
3) Confirm that the AFC implementation does not authorize any RLAN access point to operate at locations and power levels that would allow it to exceed -6 dB I/N with respect to any FS receiver.

AFC Testing and Certification

The testing necessary to ensure that the AFC system properly protects incumbents from harmful interference can be conducted at a software level to ensure that AFC implementations

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[13] *See, e.g.*, Letter from Jennifer McCarthy, Vice President, Legal Advocacy, Federated Wireless, Inc., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183, at 2 (filed Dec. 4, 2019); FWCC Comments at 29; Reply Comments of Dynamic Spectrum Alliance at 6, ET Docket No. 18-295, GN Docket No. 17-183 (filed Mar. 18, 2019) ("DSA Reply Comments"); Qualcomm Comments at 17.

[14] *Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37, et al.*, Report and Order, 30 FCC Rcd. 9551, ¶¶ 77-78 (2015).

provide the correct outputs in response to test inputs. This will allow AFC testing to be extremely thorough while also minimizing the burden on the Commission and avoiding unnecessary delay. AFC-controlled access points would, of course, be separately tested to ensure that they provide accurate inputs to the AFC with which they are designed to operate and respond correctly to AFC outputs. To this end, the Wi-Fi Alliance has an active program to develop standardized certification tests that will be made available to stakeholders and the Commission by the end of 2020.

The Commission Should Not Require AFC Centralization or Synchronization

Beyond the testing requirements described above, the FCC should be careful not to add unnecessary additional layers of regulation. Most critically, there is no need for a single, centralized AFC system, or a need for separate AFC systems to synchronize data with one another. Because the necessary incumbent data can be obtained directly from the FCC, there is no need for this data to be shared dynamically between AFC implementations. In addition, the fact that interference protection is on a single-entry basis only means that no complex radio state data needs to be stored or synchronized between AFCs. A requirement to do so, in addition to being unnecessary, would significantly increase the complexity of AFC implementations and likely foreclose many valuable types of AFC implementations.

The Commission Should Not Require AFC Device Registration or Usage Tracking

The record makes clear that access points should not be required to register with the AFC.[15] Likewise, the AFC should not be required to track the frequencies used by AFC-controlled access points. Such requirements would have little value[16] and they would have very

[15] *See, e.g.*, Comments of Microsoft Corporation at 21, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019); Comments of Open Technology Institute at New America, American Library Association, Consumer Federation of America, Consortium of School Networking, Public Knowledge, and Access Humboldt at 4, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) ("Public Interest Organizations Comments"); Broadcom Comments at 41; Reply Comments of Hewlett Packard Enterprise at 28, ET Docket No. 18-295, GN Docket No. 17-183 (filed Mar. 18, 2019).

[16] RLAN Group Comments at 33-34. Note that although some incumbents have supported an AFC device registration requirement, these same incumbents have vocally claimed that after-the-fact remediation is not an acceptable strategy for addressing harmful interference concerns. *See, e.g.,* FWCC Comments at 35 (arguing that the ability for an RS operator to decode an RLAN device identifier "would see little or no use" because "RLAN interference will have to be vanishingly rare" while continuing to argue for burdensome, and unnecessary, device registration requirements); Comments of Utilities Technology Council at 11, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) (arguing both that interference "cannot simply be remedied after the fact" while also requesting device registration requirements).

significant costs. First, a registration requirement would likely bring with it a requirement for this data to be either synchronized between AFC implementations or aggregated in a central database. Such synchronization would greatly increase the minimum complexity of an AFC implementation and limit the forms in which an AFC could be deployed.

This registration data would also, presumably, be made accessible to a certain class of users. But if nothing else, properly securing this sensitive consumer data—which would be especially sensitive in the case of registration data for transportable access points—would present a major additional burden on AFC operators. The collection and aggregation of such data would also raise concerns among an increasingly privacy-conscious consumer base.[17]

Market Forces Should be Allowed to Drive Development of Different AFC Operator Implementations

Rather than unnecessary regulatory mandates, the Commission's rules should allow the market to drive the development of AFC architectures and permit multiple entities to operate independent AFC systems. We envisage different specialized AFC implementations to support use cases including enterprise, service provider, consumer, and embedded devices, either individually or in combination (for example, an AFC operator may seek to develop a common system to support both enterprise and service-provider devices).

For the same reason, there should be no blanket requirement for all AFC implementations to interoperate with all devices. A device manufacturer should be allowed to operate an AFC system that serves only the devices it produces, and those systems should be able to operate autonomously. Finally, to ensure that there are robust market-based incentives to develop and maintain AFC implementations and to promote innovation, the Commission should permit AFC operators to charge fees for their services, as it has in other bands for operators of analogous systems.[18]

No Ad Hoc Exclusion Zones for Any Operators Seeking Special Treatment

The AFC should only be required to use data listed in ULS to protect FS licensees as well as a separate set of radio astronomy and fixed-satellite downlink sites (with appropriate interference protection criteria) to protect licensees from harmful interference. Beyond this, the Commission should not permit parties to request the creation of special exclusion zones that duplicate or go beyond the protections described above. No party in this proceeding has demonstrated that these kinds of special protections are necessary. Allowing any particular FS incumbent to enjoy any type of exclusion zone will open the door to a never-ending flood of

[17] *See, e.g.*, Comments of NCTA—The Internet & Television Association at 14, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019); Public Interest Organizations Comments at 28; Broadcom Comments at 43; DSA Reply Comments at 11.

[18] *See, e.g.*, 47 C.F.R. §§ 15.714, 96.65.

petitions for similar consideration by others, and will defeat the consumer benefits the Commission hopes to achieve in this docket.

Nor should the Commission permit unlicensed ultrawideband ("UWB") operators to request the creation of special exclusion zones. As we have shown, unlicensed UWB and RLAN devices will be able to share spectrum. We have demonstrated that the probability of RLAN operations causing harmful interference to unlicensed UWB is far lower than UWB proponents have claimed.[19] And even in situations where harmful interference could be possible, property owners and venue operators will have the flexibility to choose which unlicensed technologies to deploy, and how to deploy them. This is no different from the decisions that venue managers make today about which RLAN systems to install, which channels to use, etc. It is critical to emphasize that, as an unlicensed technology, UWB is entitled to no expectation of protection from harmful interference, and the Commission should not set the problematic precedent of granting one class of unlicensed operations priority over another. Unlicensed RLANs and unlicensed UWB should be required to share spectrum on a coequal basis, as other unlicensed technologies do in other bands.

All AFC-Controlled Devices Should Comply with Commission Security Requirements

All AFC devices should be secured against tampering, including unauthorized modification of software. To this end, AFC controlled devices should be subject to the same, updated security requirements that apply to U-NII-1 and U-NII-3 devices, as specified in Section 15.407.

[19] *See* Letter from Christopher Szymanski, Broadcom Inc., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183 (filed Jan. 15, 2020).

IV. CONCLUSION

The Commission has built a robust record supporting detailed decisions regarding virtually every significant aspect of AFC operations. We therefore encourage the Commission to expeditiously adopt rules that provide prospective AFC operators with the information they need to build production-ready AFC systems, and to begin the process of testing and certifying the first AFC implementations as soon as possible.

Respectfully submitted,

Apple Inc.
Broadcom Inc.
Cisco Systems, Inc.
Facebook, Inc.
Google LLC
Hewlett Packard Enterprise
Intel Corporation
Microsoft Corporation
Qualcomm Incorporated
Ruckus Networks, a business segment of CommScope